The Technique of Professor Keen's Surgical Clinic in the Jefferson Medical College Hospital.

BY

THOS. LEIDY RHOADS, M.D.,

Assistant Demonstrator of Pathology; Assistant in the Surgical Clinic, Jefferson Medical College Hospital.

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THE TECHNIQUE OF PROFESSOR KEEN'S SURGICAL CLINIC IN THE JEFFERSON MEDICAL COLLEGE HOSPITAL.

By Thos. Leidy Rhoads, M.D.

While the achievement of satisfactory results in surgery does not depend alone on a refinement of operative technique which is as perfect as modern science can make it, and while it is recognized that sound judgment and thorough operative ability are most important requisites to him who expects to deal successfully with surgical maladies, yet the strict attention to detail in the care of the patient, in the cycle of his existence in the hospital, prior to, during, and after operation, must bear much weight in attaining that end which is always uppermost in the surgeon's mind—the ultimate cure of the patient. The technique which is followed in a large hospital clinic where every opportunity is offered to try the various methods advanced from time to time, to discard the faulty ones, and retain those which have stood the test of rigid and most careful examination, must be of interest to the physician engaged in surgical work, but who is not in a position to make extensive personal investigations to find out what methods are absolutely reliable.

The methods employed by Dr. Keen in the Surgical Clinic of the Jefferson Hospital,

which represents one of the largest surgical clinics in the United States, are set forth in detail under the following several headings: First, the operating arena and paraphernalia at hand; second, the materials needed for each operation; third, the preparatory care of the patient; fourth, the surgeon and his assistants; fifth, the operation; sixth, the after-treatment of the patient.

The *operating arena* of the clinical amphitheatre, which is a building separate from the hospital wards, is so arranged as to be in the centre of a series of seats raised in tiers. This affords to the students on the benches a good view of the operation. Wainscoting of glazed tile, 1.5 meters in height, separates the rows of benches from the arena, which is laid with a hard, non-porous, mosaic stone floor, sloping to an air-tight drain. The floor and tile work are thoroughly scrubbed with hot water before and after each operation and mopped with a solution of bichloride of mercury 1:1000, and the floor of the amphitheatre is sprinkled with the same solution. This proceeding is made necessary by the constant moving about of assistants and the coming and going of the large body of students. More or less dust is whirled into the atmosphere, and this repeated mopping and sprinkling is done to limit as far as possible the impregnation of the atmosphere with germs, and to prevent the wound from becoming infected from germ-laden dust coming in contact with it, the dust in the air offering the only danger. The room is lighted by an overhead skylight, a provision found necessary to obtain the greatest amount of

light on the field of operation. For operations performed after sundown the necessary illumination is obtained from a drop-light of thirty-six flames suspended over the operating table, and if it is desired to have light nearer the wound, a nurse holds a portable incandescent light, which is always in readiness, in the most advantageous way and so as not to interfere with the movements of the surgeon. In brain cases at night Dr. Keen usually finds it more convenient to use an electric headlight on account of the small field of operation and to avoid crowding of assistants.

In the middle of the arena stands the operating table devised by Boldt, made of an iron frame, enameled in white, with portable plate-glass top. The simplicity of mechanism of this table is of note, as the head-rest and foot-end can be lowered, and the patient can be placed in the Trendelenburg posture at a moment's notice. On the sides of the arena are the smaller tables, two on each side, for instruments, etc., being made also of enameled iron frames and glass tops which can be lifted. These tables are scrubbed carefully with soap and water, then with a corrosive solution, and at the time of operation covered with bichloride sheets, the preparation of which will be described hereafter. At one end of the arena are two upright copper and brass boilers, of the Sprague-Schuyler pattern, each holding 115 litres, in one of which is boiling hot water and in the other water which has been boiled and cooled. The water in both has been heated to 116° C. Adjoining these is a Schimmelbusch sterilizer for boiling instru-

ments, which apparatus has the advantage of hermetic occlusion by the cover and keeps the temperature of the boiling water equal at every point. This and the boilers are mounted on frames of the same material as the tables. Opposite the sterilizing apparatus is a large marble sink with taps of running water, hot and cold, where frequent ablutions of the hands and forearms are taken without the use of basins, and on a glass shelf above the sink are glass jars of antiseptic solutions containing brushes, jars containing a solution of Johnston's ethereal soap—which is a solution of Castile soap in ether, and having added for coloring and germicidal properties a small percentage of pyoktanin—blunt-pointed orangewood sticks for cleansing nails, and a sterilized bowl containing alcohol. Alongside the marble sink is a large deep pan on an iron frame, all enameled, containing at the time of operation bichloride-of-mercury solution 1:1000 for disinfecting the hands and forearms. A covered metal vessel receives the soiled dressings, sponges, etc, which are removed from the room immediately after each operation. The plumbing of the sink and drain is frequently inspected and they are kept in perfect order. For the accommodation of visiting surgeons there are several chairs painted in white enamel in order to facilitate cleansing. At the other end of the arena is a small table which is covered with a sterilized sheet at the time of operation, on which are placed the necessary paraphernalia for the anesthetist's use—an Allis inhaler wrapped in a sterilized towel, an Esmarch chloroform inhaler, jaw forceps,

mouth gag, tongue forceps, a bottle graduated in centimeters and containing Squibb's ether, a smaller one, also graduated, containing chloroform; hypodermic syringes ready for use, a faradic battery, and an apparatus for administering oxygen by inhalation.

Before each clinic the clinic nurse and her two assistants see that the arena is placed in order. Floor, tables, etc., are cleansed as above stated, and from the adjoining room is wheeled a rolling table on which are jars for dressings, sheets, towels, sponges, etc., which have previously been prepared in a room set apart for this purpose; the table also contains instruments on metal racks which have been taken from a glass instrument-closet in an adjoining room. These jars, etc., are placed in their regular places on the glass-top tables.

In the preparation of this material the strictest asepsis and antisepsis are observed, and the transaction is entrusted only to a nurse who has received sufficient training in this special work and who understands every detail in the preparation, which includes iodoform gauze, gauze pads, dressings and sponges, ligatures and sutures, towels and sheets, gowns, brushes, drainage tubes, rubber protective and receptacles for the various solutions. All the pads, dressings, sponges, drainage tubes, etc., are kept in glass jars covered with glass lids, which are made sterile by scrubbing with ethereal soap and water, scalding and filling them to the brim with mercuric chloride solution 1:1000, and allowing them to stand thus over night. In the morning this solution is poured off and

the jars are ready for use. This sterilization is repeated each time the jar is emptied of its contents, which may be in a day or at the end of several days, so that there are always some jars in the process of sterilization.

Gauze is the most valuable of all dressings for wounds, and in its preparation that variety is selected which has the greatest absorbent power. The gauze as it comes from the shops is first boiled in a solution of carbonate of soda, rinsed out, and dried; it is cut into sections of half a meter square of four thicknesses, folded into dressings, and half a hundred of these wrapped in a sheet and placed in the sterilizer under pressure for half an hour, the temperature being raised to 116° C., at the end of which time they are removed with disinfected hands and placed in a sterilized jar. These are known as sterilized dressings. Gauze sponges are made by taking pieces of gauze one-third of a meter square, rolling each piece loosely in the form of a ball, twisting the free end and tucking it in, and sterilizing as in the case of the dressings. These are kept in a separate jar. Marine sponges are never used, on account of the uncertainty of making them perfectly sterile, and the great risk of infecting wounds.

In the preparation of bichloride gauze dressings the gauze, after the initial boiling in soda solution, is soaked for twenty four hours in bichloride of mercury solution 1:1000, wrung out, wrapped in a bichloride sheet and hung in the drying room. When dry it is spread out on the sheet, cut into pieces half a meter square, folded into dress-

ings of four thicknesses each, and these put into a sterilized jar.

Probably the most tedious to prepare of all the gauze material is *iodoform gauze*, and after experimenting with numerous formulæ in its manufacture for a number of years, the present method was evolved, and the gauze is everything that could be desired and is absolutely sterile, with the iodoform evenly distributed in the meshes.

Ten pounds (3732. Gm.) of gauze is unwound from a roll, and having been boiled in a soda solution is cut into two-meter lengths and steeped for a period of twenty-four hours in corrosive sublimate solution 1: 1000, contained in a large stone crock. At the end of this steeping the future handling of the gauze must be done with the strictest regard for antisepsis. Before removing it from the crock the nurse sees that her finger-nails are scrupulously clean, scrubs her hands and forearms energetically with soap and water, and bathes them in alcohol; this is followed by a vigorous use of the nail-brush and bichloride solution, and she dons a sterilized operating gown. As much care is used in hand disinfection in the preparation of gauze as for the operation. A sterilized sheet is spread out on a table upon which are placed two sterilized bowls, into one of which an assistant pours three pints (1.41 liters) of absolute alcohol and into the other adds the ingredients for the emulsion—three pounds (1119.72 Gm.) of glycerin and one pound (373.24 Gm.) of iodoform which has been made sterile by dry heat — the necessary quantities for making up ten pounds of

gauze. The nurse mixes the iodoform and glycerin by stirring with the hand, and adds the emulsion formed to the bowl of alcohol. The gauze is lifted from the crock, wrung out, and each of the two-meter lengths of gauze stirred in this mixture with the hands for one minute, and wrung out. The iodoform will have infiltrated itself into the meshes of the gauze, and this process is supplemented by rubbing the gauze for several minutes between the hands after it is wrung out of the mixture. It is folded lengthwise into narrow strips, rolled up like a bandage and each piece put into a small covered glass jar that has been made sterile. Each jar contains a single roll, and the gauze is laid in it in such a way that when the free end is drawn upon the gauze will unroll.

Towels and *sheets* are washed in warm water with oleine soap and are given numerous rinsings until all evidences of blood-stains are removed. After drying, parcels of two dozen towels each, wrapped in a small sheet, are placed in the sterilizer, remaining there for half an hour, the temperature of 116° C. being maintained. They are kept on hand in sterilized glass jars.

Gauze pads for abdominal operations are made as suggested by Ashton, of eight thicknesses of washed gauze nine inches square (22.9 cm.), with the edges tucked in and hemmed so as to prevent fraying; ten of these are wrapped in a towel and sterilized for half an hour in live steam under pressure; they are then put in a jar containing three-per-cent. carbolic acid solution. When needed for operation, if time permits they are

boiled in water for twenty minutes and allowed to stand in boiled water in a pan. In emergency cases they are given several rinsings in boiling water and kept in hot distilled water at the time of operation.

Rubber protective is used as a covering for dressings on a wound that discharges freely, in order to distribute the discharges throughout the dressings and to prevent infection from the air. It is washed in soap and water, scalded in hot water and kept in a jar containing three-per-cent. carbolic acid solution.

Although the object is to dispense with drainage, certain suppurating wounds, and very large wounds, make it desirable to use a *tubular drain.* These drains are made of soft india-rubber tubing and are used almost exclusively where a tubular drain is indicated; strands of silkworm-gut and iodoform gauze being used where smaller and capillary drains are needed. The tubing is washed in soap and water, cut into lengths, has holes cut in the sides, is rinsed and scalded and kept in a three-per-cent. carbolic solution, as bichloride of mercury will form chemical combinations with the rubber.

Wet gauze bandages are used to take a few turns over the dressing to hold it in place before applying the outer cotton bandage. Gauze is cut into strips eight yards (731.2 cm.) long and five inches (12.7 cm.) wide and sterilized. These strips are wound, after sterilization, on round wooden sticks five inches (12.7 cm.) long, after boiling them for one hour. The bandages thus rolled are kept in a 1: 1000 bichloride solution in a glass jar.

Where abundant discharge is expected from

wounds—as in an extensive dissection for removal of advanced carcinoma of the breast, or in general peritonitis in which, for example, bilateral drainage may be used—the primary gauze dressing next to the wound is supplemented by a large pad of *wood wool* of a size large enough to entirely cover the gauze. These pads are made by encasing a layer of wood wool one and a half feet (45.7 cm.) long, one foot (30. cm.) wide, and two inches (5. cm.) thick, with a single thickness of gauze to prevent the wood wool from separating. These pads are wrapped in small sheets and sterilized for one hour. They are folded and kept in covered sterilized jars. Absorbent cotton is required occasionally in dressing cases and is sterilized for half an hour in the sterilizer and kept in sterile jars. Gauze, however, has supplanted its use to such an extent that it is seldom used except in fracture dressings.

Small *hand-brushes* made of hog-bristles mounted on wooden backs are the best instruments with which to accomplish mechanical cleansing of hands, instruments, and operative area. The substitutes that have been suggested and tried, as cotton, lamb's wool, excelsior, etc., have not proved entirely satisfactory. The utmost care is required in the cleansing of brushes lest they prove efficient carriers of infection. They are scalded in boiling water, and those for soap and water use are kept each in a small jar containing saturated solution of boric acid; and those for scrubbing with bichloride solution are kept in a jar containing this solution in 1:1000 strength. Two separate brushes

are reserved for the patient, one for soap and water, the other for bichloride solution, and kept in the same way. All brushes used for mechanical cleansing from dirt after examination of the rectum, cancer of the uterus, etc., have *black* bristles, while the brushes used for scrubbing with bichloride solutions are made of *white* bristles. By this means no interchange of the brushes can be made. Brushes used in purulent wounds are destroyed after operation.

The preparation of *animal ligatures* has been a matter of most careful investigation for many years. All other material has finally been discarded in favor of catgut, which is undoubtedly the ideal ligature, but the manner in which it could be rendered absolutely sterile and still retain the peculiar properties required of it has been a bone of contention. Different methods have been followed in past years in its preparation, among them methods of Fowler and Leavens, by which catgut is kept in alcohol in sealed tubes; the preparation by formalin recently proposed by Senn; cumol catgut, etc.—all of which have finally been abandoned as unsatisfactory, in that the apparatus needed is expensive and troublesome, considerable time is consumed in the preparation, and the gut is less efficient as to strength and durability.

Mr. Johnston, of Jefferson Hospital, devised the method of preparation of catgut which has since been used and which has proved eminently satisfactory. Raw catgut, from the submucous coat of sheep's intestines, as obtained from the shops, is steeped

in absolute ether entirely purified from sulphuric acid, to remove the fat,—light gut remaining twenty-four hours in the ether and the heavier gut forty-eight hours. When it has been steeped a sufficient length of time in the ether the gut is transferred directly into a corrosive sublimate solution, consisting of mercuric chloride 40 grains (2.6 Gm.), tartaric acid 200 grains (12.96 Gm.), and alcohol 12 ounces (354.88 Cc.). The lightest weight gut should not remain in the corrosive mixture longer than from five to ten minutes, the next size from ten to fifteen minutes, and the largest sizes from twenty to twenty-five minutes. While the gut is being steeped and before it is transferred from the ether to the corrosive mixture, jars for keeping it ready for use are prepared by thoroughly scalding, filling them with an aqueous corrosive-sublimate solution 1: 1000, allowing them to stand thus filled until the following day. This solution is then emptied and the jars nearly filled with alcohol (95 per cent. strength) and containing palladium bichloride in the proportion of $\frac{1}{16}$ of a grain (0.0040 Gm.)—*i.e.*, two drops of a palladium bichloride solution containing 15 grains (0.972 Gm.) of the salt to the ounce—to a pint of alcohol. By experiment it has been shown that more of the true bichloride of palladium will not stay in solution in alcohol, and when a precipitate occurs through excess of the palladium the whole goes to the bottom and is not again soluble in alcohol. The gut being lifted with an aseptic tenaculum from the bichloride mixture, is dropped into the prepared jars of palladium-alcohol and is ready for use. Cat-

gut thus prepared is strong, pliable, and smooth, and keeps indefinitely as far as yet known. Careful laboratory experimentation by Dr. Coplin and Dr. Harris, and extensive clinical observation, prove the fact that it is sterile. When an operation is about to be performed the outside of the jar is rinsed with hot bichloride solution 1:1000, the glass stopper removed, and the mouth of the jar well wiped with the solution. The quantity of gut judged necessary for the operation is lifted from the jar by means of a sterilized tenaculum, and dropped into a dish previously sterilized and containing sufficient alcohol to cover the gut. If more gut is removed from the jar than is necessary for the operation the quantity left is immersed in the mercuric chloride solution for five minutes and transferred to the stock jar. This precaution gives absolute safety against infection.

When it is desirable to have ligatures or buried sutures remain intact for a longer time than it usually takes for them to be absorbed—the limit of this time being usually from five to six days—the gut is made more durable by chromicizing it. It is steeped in absolute ether as before for twenty-four hours. Commercial ether contains a trace of sulphuric acid which ultimately softens and rots the gut, so it is not used. The gut is transferred to the corrosive-sublimate solution from five to thirty minutes, according to its thickness; it is then washed in pure alcohol to remove any deposit of bichloride of mercury, and transferred to a solution made by adding half a pint of absolute alcohol to an equal amount of sterile water in

which has been dissolved five grains (0.324 Gm.) of bichromate of potassium. The gut remains in this solution eighteen hours, is rinsed off in alcohol, and dropped into a sterilized jar containing pure alcohol, in which has been dissolved one-sixteenth of a grain (0.0040 Gm.) of bichloride of palladium to the pint. This gut will last from fifteen to twenty-five days.

Kangaroo tendon is used in preference to catgut in certain cases, as in an operation for the radical cure of hernia where the several muscular layers are sutured to Poupart's ligament after the method of Bassini or Halsted. The tendon is here used on account of its greater permanence, as it is not absorbed for two or three months. The raw tendon having been soaked in absolute ether for forty-eight hours, is boiled at a temperature of 100° C. in alcohol for one hour. This temperature is maintained by means of a water-bath. It is then put in the mercuric chloride solution mentioned in the preparation of catgut for ten minutes, and kept in sterilized glass-stoppered jars containing bichloride of palladium one-sixteenth of a grain (0.0040 Cc.) to the pint of absolute alcohol. Pieces of the tendon thus prepared, placed on sterilized agar and gelatin and immersed in bouillon, have yielded no growth after numerous experiments by Dr. Coplin.

For suturing, silk, silkworm-gut, and silver wire are used. Silver wire is used principally in suturing bone in fractures and as a subcuticular stitch where stitch-hole scars are to be avoided. It is boiled with the instruments.

Silk of various sizes, received in skeins, is wound on glass spools, and several spools put in a test-tube which is plugged with cotton. The fractional method of sterilization is used when there is no urgent demand for the silk. The tubes are plugged with cotton and are placed in the sterilizer, a temperature of 100° C. being maintained for one hour each day for three successive days. At this temperature on the first day all adult bacteria with which the surgeon has to deal are killed; on the second day the spores, and those spores which may have developed into full-grown bacteria, are destroyed; and on the third day any spores which may finally remain are sure to be destroyed. When, however, there is not sufficient time to follow this method the tubes are placed in the autoclave, which is a steam boiler in which the steam is locked up tight, so that a high temperature can be reached; it is kept in this for thirty minutes after the mercury has reached 116° C., and on removal is kept in the tube until needed, when the cotton plug is removed and the spools are dropped in a sterilized dish containing absolute alcohol.

Silkworm-gut is used generally in closing wounds with interrupted sutures. It is received in strands each one foot long; these are scrubbed with a brush and soap, rinsed several times in water and in alcohol, and immersed in bichloride solution 1:1000 over night. They are kept in absolute alcohol in a sterile glass-stoppered jar.

Cotton roller bandages are kept in a separate jar and sterilized by steam in the sterilizer; four different widths are used, from

one to four inches (2.5 cm. to 10.2 cm.) each, eight yards (7.3 meters) in length.

In bone operations a small jar of Horsley's *wax* is always at hand, and its applicability is nowhere better indicated than in the oozing, sawn end of bone in amputations, the hemorrhage from which is controlled immediately it is applied; its value as an agent in controlling hemorrhage cannot be overestimated. It is made of seven parts of beeswax to one part each of almond oil and salicylic acid.

Iodoform collodion is used to seal small superficial wounds where it is possible or desirable to dispense with elaborate dressings, as after removal of a small sebaceous cyst from the face. A few thicknesses of sterilized gauze sufficiently large to cover the sutures are laid over the wound and painted with collodion, which acts as a thorough protective against atmospheric influences.

But one dusting powder is used in the clinic—*iodoform*—and that very rarely. It is sterilized by heat, and is not used as an active disinfecting agent, but as a drying powder in rare instances, where it will aid in absorbing secretions from a large granulating surface. Should infection occur it renders ptomaines harmless by forming innocuous combination with them, as shown by de Ruyter and Behring. Its use, however, is limited almost entirely to tubercular cases, as it exerts such a decided antitubercular influence. The improvement noticed in these cases under its use is second only to the action of mercury in syphilis.

The various *antiseptic solutions* that are made for each clinic, and kept in large flasks,

are solutions of mercuric chloride, carbolic acid, and boric acid. Mercuric-chloride solution is made by adding two drachms (7.39 Gm.) of the salt to a gallon of distilled water, as in other water the earthy substances combine with the mercury. This makes a strength of 1:500, and by adding hot water in equal amount to the solution at the time of operation it makes the standard solution of 1:1000. In order to distinguish it from other solutions it is colored red by adding a drop of a saturated alcoholic solution of eosin to a pint of the mercurial solution. A five-per-cent. carbolic-acid solution is known at a glance by its blue color, a drop of a saturated aqueous solution of pyoktanin giving it this color; this solution is also diluted one-half when used. Boric acid is kept in saturated solution and diluted to any strength desired when needed. Solution of sodium chloride, or normal salt solution, is made by dissolving six grammes of table salt in a liter of pure water, which is filtered through druggists' filter-paper into flasks; these flasks are plugged with cotton and sterilized by heating to a temperature of 116° C. for half an hour. It is used principally in irrigation in cavities, for hypodermoclysis and enteroclysis, and for intravenous injection in cases of shock or great loss of blood. For hypodermoclysis and intravenous injection the apparatus of Collin (see American Year-book of Medicine and Surgery, 1897, page 224) is used very advantageously; and for enteroclysis a rectal tube and fountain syringe are always at hand. There are also in readiness a Paquelin cautery adjusted for immediate

handling, an aspirating apparatus, and tracheal tubes; splints, etc., and an outfit for bacteriological examination are kept in the adjoining room with the instruments.

The Preparation of the Patient.—The object of this is twofold: first, to put him in better physical health and raise the general tone of his system, thus increasing his tissue resistance to the invasion of infectious organisms; and second, by a series of local cleansings, in which the mechanical means is of the highest importance, to render surgically clean the area to be operated upon. It will depend upon the exigencies of the case whether the period of preparation shall be a single day or can be extended several days, the latter being by all means preferable if the case be one of gravity and there be no special urgency. Especially will it be desirable to lengthen this treatment if the patient is suffering from any chronic organic disease in conjunction with his surgical ailment, allied conditions being not infrequently met with; and it is a matter of some gravity in certain cases to decide whether any operation is justifiable or not. As a rule in organic cardiac disease the valvular lesion does not contraindicate operation, and even the gravest of operations may be performed without any untoward results. In such cases the utmost care is taken in administering the ether, which is given in a minimum amount necessary to induce anesthesia, and the operation is done speedily—never, however, hastily. If there be serious advanced organic disease of the kidneys, an elective operation is withheld. If, however, surgical interference is necessary to save life

—as in amputation for gangrenous extremities, a vesical calculus which is causing much mischief, or a cervical tumor which is encroaching upon the trachea—operation is performed with the aid of chloroform in spite of the nephritis. Chloroform anesthesia is used in these cases, as the weight of professional opinion leans in favor of it, and as shown in the tabulated list of anesthesia cases summed up by Dr. Da Costa.

The patient is given a hot tub-bath on admission, is furnished with fresh laundered underlinen and nightshirt, and put to bed. Confinement to bed prior to operation accustoms him to his unnatural experience, relieves him of the constipation and sleeplessness which always follow this change, quiets his heart and lungs, and keeps him in an equable temperature. If he be an excessive user of alcohol, stimulants are cut down to a safe dose; if he be a moderate user of spirits, however, the alcohol is cut off entirely. A saline is administered at once and repeated until the bowels are completely unloaded. Some time during the first day the resident surgeon takes a full history of the case, comprising in detail the family history, with especial inquiry as to any hereditary taint, the past history, and the history of the present illness, with a minute examination and description of the condition of special organs. The family history will aid in arriving at a definite conclusion as to the influence of heredity; the past history will disclose the patient's prior illnesses and his probable liability to infection; the history of the present trouble will give a detailed account of the

cause, onset and development of the disease for which the patient has sought relief. The examination of special organs, heart, lungs, liver and kidneys will give the operator exact information as to the patient's general condition, and this is taken well into account and will have much weight in deciding as to what extent operation is feasible. Any unusual phenomenon, mental or physical, is noted in the history report under Remarks.

On the first day a careful examination of the urine is made by the anesthetist in person; this covers a reaction test with litmus, the specific gravity, a test for albumen and sugar. In testing for albumen the acetic-acid test is used, which is made by pouring into a small test-tube half a drachm (1.8 Gm.) of a solution of equal parts of acetic acid and water, which solution is always kept on hand, and dropping into the tube a crystal of ferrocyanide of potassium, shaking it until the crystal is dissolved. The urine is then allowed to trickle down the side of the tube, and at the point of junction, if there be a trace of albumen, a white line will appear. If any albumen is found the amount of urine voided during the next twenty-four hours is collected, and a small quantity boiled and tested for the amount of urea present by the Doremus apparatus.

In testing for sugar Haines' solution is employed, which consists of a mixture of cupric sulphate 30 grains (1.848 Gm.), distilled water ½ ounce (14.79 Cc.), glycerin ½ ounce (14.79 Cc.), and liquor potassii 5 ounces (147.8 Cc.). One drachm (3.70 Cc.) of this solution is boiled gently, six drops (0.37 Cc.)

of urine added, and if any sugar is present a yellowish-red precipitate will be deposited in the bottom of the tube.

A microscopic examination for blood or pus corpuscles, tube casts and crystalline or other deposits completes the urinary examination. Hemorrhage from the urinary tract will demand further investigation. A moderate number of hyaline casts will not be of any weighty significance or have any serious bearing against operation.

During the several days preceding operation the patient is kept under rigid ward discipline and a strict regimen and confined to his bed. On the first night the imaginative horrors of hospital life usually present themselves with unusual force, which keeps him wakeful and restless, so he is given fifteen grains (0.97 Gm.) of trional if necessary in hot beef-tea, before the lights are turned low. The sound sleep which this potion induces has a beneficial effect upon the patient's nervous system, which is noticeable the following morning, when he will be found more cheerful and full of courage. If a tonic is necessary he is given two grains (0.13 Gm.) quinine sulphate and $\frac{1}{30}$ grain (0.0022 Gm.) strychnine sulphate at regular intervals of four hours each or longer, and he is kept on light, easily digestible, nutritious food. The hot bath, which is a prominent factor in gaining excellent results in surgery, is repeated daily to stimulate proper skin action, and gentle massage produces a more active circulation, supplying to muscles exercise which requires no effort upon the part of the patient and is an excellent adjunct to the prelim-

inary treatment which aims to improve his general condition. The application of these manipulations to the abdomen also increases peristalsis and induces a daily evacuation of the bowels—which it is extremely important should occur, for patients in whom the bowels are unloaded are less liable to infection—and the number of movements is recorded on a temperature chart, together with the quantity of urine secreted in each twenty-four hours. The morning and evening temperature is recorded on a Wilson chart, with the pulse-rate and the number of respirations per minute, so that the surgeon on making his daily rounds can infer on glancing over the chart what is the condition of the patient and whether there is any change from the record of previous days.

Up to this time the treatment has been only constitutional and moral. On the day before the operation attention is more especially directed to the local trouble for which the patient has sought relief. A series of local cleansings by mechanical rubbings and chemical disinfectants is now instituted, with the object of making the area surrounding the part to be incised or excised, an aseptic field. This disinfection is done twenty-four hours before operation by the head nurse of the ward and her assistant, or by the orderly and his assistant if it be a male screen case. These nurses have been thoroughly schooled in the methods and objects of asepsis and antisepsis, by the Resident and the Directress of the training school. Screens are thrown around the patient's bed, and the part to be operated on is exposed and surrounded by

clean towels. The operative area is lathered with soap and brush, the soap is well rubbed into the skin with the hand, the hair covering it removed with a razor and the part rinsed off with distilled water as hot as the patient can bear it. A hot moist towel is laid over the part temporarily, while material is furnished for the further disinfection. From now on until the patient's final discharge from the hospital the strictest antisepsis is observed with all objects that come in contact with the operative field. The nurse scrubs her forearms and hands, paying special attention to her finger-nails, with soap and water and with alcohol, while her assistant wheels the small ward carriage in which are bottles of solution and jars containing dressings to the bedside, and pours out into two separate sterilized bowls a solution of bichloride of mercury 1:1000, in one of which the nurse scrubs her hands and forearms after using the alcohol, the other of which is reserved for the patient. Each bowl contains its own sterilized brush. The moist towel is removed from the patient and the area before mentioned rubbed with alcohol, the nurse using for this purpose a ball of sterilized lamb's wool enclosed in sterilized gauze. The assistant pours the alcohol on the part slowly as the nurse proceeds with the rubbing, and the assistant does not touch anything that will come in contact with the area being disinfected. After the alcohol rubbing the assistant removes the lid from the jar containing towels, and the nurse places a sterilized towel on each side of the area. The bichloride solution is then handed,

and the part scrubbed fully five minutes with as much force as the patient will comfortably bear; it is dried with a sterile towel, pieces of corrosive gauze laid over the whole area and held in place by a bandage or binder adapted to the particular area,—a Scultetus bandage if the prepared part be the abdomen or back, the classical spiral if the part be an extremity. This completes the primary disinfection. The patient's bed is arranged tidily and the screens removed from around it.

The extent of the area that is thus cleansed will depend altogether upon its location and upon the gravity of the operation to be performed. A sebaceous cyst of the scalp, for example, would require shaving and cleansing of the growth and a limited area surrounding it, a towel properly placed at the time of operation protecting the operator's hands and instruments from coming in contact with the rest of the head; while a proposed craniotomy would necessitate cleansing and shaving of the entire head, neck and shoulders, including eyebrows and beard, special attention being given to the external ear. A small fibroma of the breast where diagnosis is absolutely certain would require cleansing only of the mammary gland and immediate vicinity, while the removal of a carcinoma of the breast, whether involvement of the axillary glands be previously detected or not, or in a case of any mammary growth simulating malignancy and where positive diagnosis cannot be made before incision, would demand an extensive surgical toilet reaching from the line of the jaw to the level of the umbilicus and from

the opposite shoulder to the middle of the back, including the arm of the affected side.

In operations upon the pubic, perineal and ischio-rectal or sacral regions in the female, the pubes, vulva and neighboring parts are shaved and cleansed, the vagina is scrubbed with a pledget of lamb's wool and a mixture of an ounce (29.57 Cc.) of the tincture of green soap to one pint (373.24 Cc.) of a two-per-cent. creolin mixture, followed by copious douches of warm sterilized water; this in turn by a boric acid douche three drachms (11.09 Cc.) to the pint. A bichloride dressing is then applied, and held in place by a broad T-binder. For douching the vagina the boric acid solution is used in preference to the bichloride solution, which is still used extensively in some hospitals but which does not exercise the slightest germicidal influence upon micro-organisms in the vagina, as Steffeck has shown, and furthermore by irritation causes lessened tissue resistance and greater liability to infection, as Schimmelbusch has proved by actual experiment.

Operations on the rectum will require frequent laxatives and enemas beforehand, and at the time of operation a tampon of lamb's wool, with string attached to facilitate its removal, is pushed into the bowel, and located above the operative site in order to keep the intestinal contents from soiling the wound.

In abdominal operations the umbilicus will require special attention, and where the folds of the skin run down to such a depth that it is impossible to cleanse it thoroughly, it is covered by a wet bichloride mop, and at the time of operation iodoform collodion is poured

over the umbilicus, shutting it off entirely from the operative field. In operations on the lower extremities it will often be a matter of considerable patience to thoroughly disinfect the skin of the feet, which usually are not bathed regularly by the class of patients who fill the hospital wards, and in order to get rid of the excrementitious matter, and the saprophytic and pathogenic bacteria that are sheltered by the hard callous epidermis, a hot compress of weak bichloride solution surrounded by rubber dam is applied to the extremities after each daily bathing and allowed to remain. This is followed by scrubbing with the solution. The callous epidermis comes away by maceration after several such compresses have been applied. In operations upon the genito-urinary tract, besides the cleansing of skin, scrotum, and penis in the male, if necessary the bladder is irrigated three times a day with a solution of boric acid ten grains (0.648 Gm.) to the ounce, and salol and boric acid, each five grains (0.324 Gm.), are administered every four hours to disinfect the urine.

In operations in the mouth, pharynx, nose, or on either maxilla, the patient uses a mouth wash and gargle of a solution of boric acid and Listerine, every four hours, and uses a moderately stiff tooth-brush and precipitated chalk at least thrice daily. The nose and mouth are also thoroughly sprayed every two hours with a boric acid solution for two or three days.

The evening before the day of operation the patient is given two drachms (7.39 Gm.) of Rochelle salts, which dose is repeated

early the following morning, and when the bowels have moved the rectum is flushed with a copious soap-and-water enema.

On the morning of the operation day he is given a hot sponge-bath in bed, followed by an alcohol rubbing. The dressings applied the previous day are removed, the disinfection repeated, and fresh dressings applied. He is not allowed to rise from the bed unless it be for evacuation of the bladder or bowels, as thus he will expend the least amount of vital force. A final enema of soap and water is given to thoroughly cleanse and empty the rectum, so that its mucous surface will be in condition to absorb, should extreme shock or excessive hemorrhage later on call for enteroclysis and the injection of stimulating enemata. A cup of tea or coffee or beef-tea is taken five hours before operation, and nothing else passes the lips, unless it be a small draught of brandy. He is given a suit of clean underlinen, a nightshirt, and loosely fitting cotton-flannel stockings which envelop the whole limbs and are tied loosely around the waist. The nurse removes any jewelry and false teeth worn by the patient, and at the stated time he is wheeled on a rolling table to the anesthetizing room.

On arriving at the hospital the surgeon and assistants remove their coats and waistcoats in the surgeon's private room, roll up their sleeves above the elbows, and put on freshly laundered white linen coats with short sleeves. The surgeon enters the clinic and scrubs his hands and forearms with pyoktanin-ethereal soap, or with green soap, and a brush for at least five minutes. This pri-

mary cleansing is done before the students at each clinic as an object lesson to them. Having dried the hands, the nails, which are always kept reasonably short and evenly trimmed, are thoroughly cleansed with the ivory instrument made for this purpose, or with the blunt-pointed orangewood sticks with which the clinic is supplied. The hands and forearms are bathed in alcohol and finally scrubbed with a sterile brush in the bichloride of mercury solution 1:1000. The surgeon puts on a long rubber apron, and over this he wears the linen operating gown, the loose sleeves of which are drawn above the elbows and tied snugly with tapes.

The assistants, who have previously disinfected their hands in a similar way, in the meantime see to the immediate preparations for operation.

The assistant who will have charge of the instruments refers to a Keen "Instrument Blank," and selects from the instruments in the racks those necessary for the operation to be performed. These are wrapped in pieces of gauze to facilitate their handling and put into the Schimmelbusch sterilizer, where they are boiled thirty minutes, one per cent. of soda being added to the water to prevent their rusting. Paired instruments are separated before boiling; cutting instruments are separately enveloped in cotton to retain their sharp edge; needles are wrapped in a separate piece of gauze. Two all-metal hypodermic syringes are boiled at the same time, for the anesthetist's use. If the operation be on an extremity, the Esmarch apparatus is immersed in a five-per-cent. carbolic solution

and remains in this solution until needed. The sterilized trays are placed in position on the glass tables for holding the instruments after they are boiled, and hot sterilized water is poured in the trays, which are covered over with towels.

The assistant in charge of the ligatures and sutures immerses the jars containing these in mercuric chloride solution 1:1000, removes the tops, and lifts from each with a sterilized tenaculum the necessary quantity of catgut (wound in rings) and drops it into sterilized bowls containing absolute alcohol. The ligatures are cut into twelve-inch lengths, the quantity being estimated for the kind of operation to be performed. Spools of silk are likewise emptied from their separate tubes into sterilized bowls containing absolute alcohol; silkworm-gut and kangaroo tendon remain in their respective jars until needed.

The clinic nurse and her assistant, having disinfected their hands, cover the tables with sterilized sheets and arrange the jars on them properly and make up the different solutions.

At the beginning of the clinic the patients from the last clinic are brought in from the wards, on rolling beds, and brief remarks made upon the progress of each case; the wounds are dressed before the students so that they can note and keep in touch with the proper methods of dressing cases. The result of the pathologist's examination in the case is also read to the class, and while this is transpiring the chief clinical assistant inspects the preparations and sees that everything is in perfect readiness for operation.

The *anesthetic* is administered in a room apart from the clinic in order that the disturbance to the patient's nervous equilibrium, which would be brought about by bringing him while still conscious before a large body of students, may be avoided, and that he be spared the sight of the immediate preparations for operation and the necessary display of instruments. Occasionally the anesthetic is administered before the class for the purpose of instruction. The administration of the ether (which is commonly used for anesthesia) is not commenced until all the preparations in the clinic are nearly completed and the surgeon is ready to proceed with the operation; the practice of anesthetizing the patient before preparations for the operation are completed, and sustaining the anesthesia until the surgeon is ready to proceed, is discountenanced.

In order that the intervention of the operator will not be necessary during the process of anesthesia, should the patient show signs of failing heart or respiration, a skilled and trustworthy assistant is selected to give the anesthetic, who is competent to act in case of emergency. The anesthetist's whole attention is devoted to the administration of the drug, and he is not allowed to watch the operation.

For administering ether the form of inhaler devised by Dr. Allis is used on account of its simplicity, lightness, and efficiency. For chloroform the Esmarch inhaler is used, except as described below. The anesthetist uses a bottle graduated in centimeters and having a Tweed dropper. Squibb's ether

and chloroform are invariably used. The anesthetist is also supplied with mouth-gag and tongue forceps. An assistant has charge of the hypodermic syringe, which has been tested beforehand to see that it is in working order, and brandy and solutions of strychnine, atropine and digitalis are placed on a small table within reach.

Before exhibiting the anesthetic the anesthetist examines carefully the heart and lungs, loosens any constriction around the neck, chest or waist, and inspects the mouth to see that it contains no false teeth or other foreign body, as tobacco. The patient's statement is not accepted in this matter, but personal inspection is necessary, for it is quite common for patients to deny the presence of false teeth.

While heart disease is not considered a positive contraindication to the administration of an anesthetic, its presence makes the anesthetist more wary, and in valvular lesion the administration will be made with especial care. The heart beat usually improves under the judicious administration of ether. It is true that anesthetics are highly dangerous in people with fatty hearts, but the shock of operation without anesthesia is equally or even more dangerous, and the surgeon has the choice of the lesser of two evils. The presence of extensive capillary bronchitis also offers a more or less serious drawback to administering the anesthetic, as the amount of mucus secreted may cause asphyxia, and the least amount of the anesthetic is given that is capable of producing the desired effect. In these cases chloroform is gener-

ally used by preference, and if care is taken in the administration there is seldom any serious result.

The urinary report is examined beforehand to ascertain the condition of the kidneys; the presence of albumen and casts in the urine, while not contraindicating operation, make the peril of anesthesia greater, and certain dangers are to be watched for and guarded against. But while in these pathological conditions of heart, lungs and kidneys there is more danger than where these complications do not exist, there is really no condition of these organs, as Hearn has clearly proved, that offers a positive contraindication to the use of an anesthetic in a case requiring surgical interference.

Inquiry is made as to the patient's habits, whether he be addicted to the use of alcohol or not. Alcoholic patients are peculiarly liable to congestions, and pass through the exciting stage of anesthesia with considerable struggling. These cases are usually given a hypodermic injection of morphine a short time before leaving the ward to aid in bringing about insensibility with very little of the anesthetic.

Ether is the drug commonly used for anesthetizing in the clinic, as it is less dangerous in general cases, though it is not as agreeable to take and slower in action than chloroform. However, the sudden and alarming syncope which chloroform induces occasionally may come on so rapidly that it may prove fatal almost before an attempt can be made to revive the patient, and it is for this reason that it is not more generally employed. As Hare

has shown by experiment, chloroform may kill by paralysis of the vasomotor and respiratory centres as well as of the heart, whereas ether acts fatally through the respiration alone, the heart rarely being affected. In case of alarming symptoms from ether there is usually sufficient time to undertake means of resuscitation which are likely to be of avail. Practically the only cases in which chloroform is selected are those in which there is profuse bronchial secretion or advanced kidney disease, and in operations on the mouth and nose, where it is administered on a pledget of cotton held in a forceps so as to interfere as little as possible with the movements of the operator.

Having ascertained the condition of his patient the anesthetist assures him there is no danger, and the patient being recumbent the dry inhaler is placed over his face, letting him take several respirations to gain confidence. He is instructed to take deep inspirations and not to expel the air too rapidly. This method of breathing allays to a certain extent the supersensitiveness of the bronchial mucous membrane, and the ether is received more kindly and is not apt to produce coughing. Only a few drops of ether are poured in the inhaler at first; this is repeated every few minutes, the anesthetist giving the patient time to become accustomed to the vapor and to acquire confidence, and encouraging him to take it quietly and not to be alarmed. A little patience exercised at the outset proves a saving of time and trouble in securing the desired effects, and the result is a much more satisfactory anesthesia, with less

shock than where the ether is crowded and force is used to restrain the struggles of the patient.

As soon as the patient is fully under the influence of the anesthetic he is wheeled on the rolling table, on which he was etherized, to the operating arena, where he is lifted to the operating table.

While the operation is in progress certain *complications* of the anesthetic state are liable to arise which must be met and treated the moment they occur. Of these, vomiting is the most common, and while it is disagreeable to the operator, particularly if he be operating about the face or performing a celiotomy—the vomitus being liable to infect the wound in the former case, and the rigid muscles from straining interfering in the latter—the danger lies in the fact that a part of the vomitus may pass the glottis and enter the trachea. The local anesthesia of the parts interferes with the usual guarding of the passageway to the lungs, and the patient may become asphyxiated from particles of food lodging in the trachea or bronchi. The necessary precaution is taken to guard against this occurrence by withholding food for at least five hours before operation. The anesthetist knows that his patient's stomach is empty, so has nothing to fear from this source, for should some of the vomited matter enter the patient's trachea, being nothing but a thin frothy mucus, it can do no damage to the mucous surface; the principal harm is that it interferes with the progress of the operation and causes much cardiac depression if long continued. Vomiting is usually due

to incomplete anesthesia, the admixture of too much air with the vapor. The patient's head is lowered and extended and turned to one side, so the material may be drained off in a towel and the anesthetic persistently administered until vomiting ceases and complete relaxation occurs.

Bronchorrhea may be a distressing complication to the administration of the anesthetic, inasmuch as the free secretion in the bronchi and bronchioles may interfere with thoroughly anesthetizing the patient, and the patient is more prone to nausea from swallowing much of the mucus which is heavily soaked with ether. Bronchorrhea usually occurs during the earlier stages of anesthesia, and if judicious care is taken not to force the ether from the start the mucus secreted will usually not be of an amount sufficient to cause any distressing symptoms. When it occurs the patient's head is turned to the side and the mouth wiped frequently with a small gauze sponge in a sponge-holder to get rid of the accumulation.

Cyanosis in greater or less degree may occur in the early stages of anesthesia, just before the stage of relaxation or later in the progress of the anesthetic. In the former case it usually occurs where bronchorrhea is profuse, and if the cyanosis be only slight the ether is continued until the patient is relaxed, and the bronchial secretion is drained off as rapidly as possible by wiping out the mouth frequently with a gauze sponge. If the cyanosis becomes marked, however, and the trained eye of the anesthetist recognizes an alarming condition, the ether is suspended

and efforts made to revive the patient. During the progress of the anesthesia cyanosis may come on from closure of the epiglottis or "swallowing the tongue." When the condition becomes alarming the inhaler is removed, the patient's head is brought over the edge of the table and forcibly pressed backwards. This maneuver lifts the hyoid bone and with it the epiglottis. Cold water is at the same time dashed on the face with a towel. Should this not suffice the mouth-gag is fixed in position and the tongue pulled forward, rhythmical traction being made by means of a forceps with a prong on one blade which transfixes the tongue; this does far less injury to the tongue than forceps which act only by pressure. The throat is cleansed of mucus and the epiglottis lifted by pressing forward the base of the tongue with a blunt instrument or the finger. Artificial respiration by Sylvester's method is rarely necessary. Hypodermics of strychnine, atropine, digitalis or brandy may be necessary for a failing pulse or shallow respiration.

When it is deemed more advisable to use chloroform for anesthesia the Esmarch inhaler is generally used, but where operations on the mouth demand all available space and light after the patient is fully anesthetized, it is administered on a pledget of cotton clamped in a forceps. The cotton is held several inches above the mouth so that the chloroform vapor will be well mixed with air. The lips and nose are smeared with cosmoline to prevent blistering, and the utmost precaution is taken to anticipate syncope. Should this occur,

means to counteract it are instantly taken. The chloroform is suspended, the head is lowered and thrown back, and the tongue drawn rhythmically forward, and if this does not suffice artificial respiration is practiced at once without waiting for the breathing to cease. An assistant gives a hypodermic injection of ammonia, followed by $\frac{1}{20}$ of a grain of strychnine sulphate. The artificial respiration is kept up for some time to urge the blood through the heart, and hypodermics of brandy and strychnine repeated at short intervals until improvement occurs. The writer has given thirteen hypodermic injections of strychnine of $\frac{1}{20}$ of a grain each within two hours in such a case before the heart finally regained its accustomed beat. There were no ill after-effects from the cumulative action of the drug.

If necessary, faradism is used over the phrenic nerve (one pole over the epigastrium, the other over the course of the phrenic at the root of the neck) and mustard applied over the heart and cervical spine. Such procedures are rarely called for, however, if the drug be administered very slowly and plenty of air be mixed with the vapor. The writer has seen but two instances in which active measures were demanded to resuscitate the patient while chloroform was being administered, during a period of seven years in the Jefferson Clinic. Both of these recovered, the operation being temporarily suspended in each case. In one of the cases it was necessary to completely invert the patient, holding him up by the legs and compressing the abdomen rhythmically (which Hill has shown

to be the best means of resuscitation) until the circulation was re-established and he showed signs of returning respiration. Such extreme procedures are fortunately, however, rarely demanded.

The Operation.—In the selection of a typical case for description of operative technique as practiced in the clinic we have a wide choice. The region of the neck, with the variety of tumors and cysts that are liable to be found here, is probably invaded as often as any other part of the body. Most of these growths are of glandular origin, and many of them are malignant, so the case before us, we will then suppose, is a lympho-sarcoma of the neck which has not yet assumed such proportions or invaded the tissues so extensively as to make operative measures unjustifiable.

The fully anesthetized patient, having been lifted to the operating table, is covered with warm woolen blankets, the edges being tucked under his back to reduce as far as possible the loss of body heat, and if necessary he is surrounded by hot-water bottles to supply by artificial means enough heat to make up the deficiency of the amount that may be lost. This will greatly lessen the subsequent shock which often follows a prolonged dissection. The temperature of the room is kept at a reasonably comfortable mark, and drafts are avoided. To prevent his becoming chilled from the solutions these are always used quite warm and the table is placed in a slight Trendelenburg position, the foot being raised about three or four inches above the level of the head, so that all fluids run towards the head. This avoids

wetting the blankets and other clothing and is insisted upon by Professor Keen in all operations on the head, neck and breast as a minor but important point in the technique.

The dressings are then removed and the face, neck, chest and arms to the elbows are scrubbed with soap and water, rinsed off with water and dried, and washed with alcohol. For this scrubbing a special brush reserved for the patient is used. A sterilized sheet is thrown over him, with the ends hanging over the sides and foot of the table, and fastened over his shoulders. The head is encircled with a sterilized towel, covering all the hair, and a sand pillow wrapped in a sterilized towel is placed under the shoulders to raise them and allow the head to drop backward. A sterilized towel is wrapped around the inhaler. The operative area is finally scrubbed with solution of bichloride of mercury 1 : 1000, care being taken that none enters the eyes or nasal and buccal cavities; and after plugging the external ears with sterilized cotton the part is ready for operation.

Notwithstanding these painstaking efforts at repeated cleansings, the staphylococci *epidermidis albi* are still found in the deeper layers of the cuticle, their accustomed habitat, but as they rarely show any tendency to pathogenesis and have never more than a local significance the rôle they play in the future proceedings is usually only one of slight importance.

The two immediate assistants, both of whom wear sterilized operating gowns so as to have perfect aseptic relations with the surroundings, take their proper positions at the

table, the chief assistant to the operator's right, the second assistant opposite him. The assistant in charge of the instruments having removed them from the sterilizer and laid them in trays containing sterile water, selects a sharp scalpel and dissecting forceps, which he hands to the operator, and clamps a dozen or more hemostatic forceps to the sterilized sheet covering the patient, where they can easily be reached by the assistants. Fastening the forceps in this way to the sheet prevents their falling on the floor. A basin full of dry gauze sponges stands on a table within easy reach. The fourth assistant busies himself with the ligatures and sutures, cutting them into proper lengths, and threads the needles. Two nurses with aseptic hands look after the solutions, which they change frequently, and hand sponges, dressings, etc., when needed.

The patient's head is turned to one side and held firmly by the anesthetist, sterile gauze pads are pushed back of the neck on each side to absorb blood, and the operation is begun by making a free incision over the growth in the line of the sterno-cleido mastoid. After the platysma and fascia are divided the deep fascia is opened the whole length of the incision. The veins that are encountered in these superficial dissections are clamped and divided. The sterno-cleido will usually be found adherent to the growth and stretched over it. From now on the dissection will often be most difficult and tedious, and demands the exercise of the highest qualities of a capable surgeon. There is probably no other procedure in the category of surgical

operations that is more difficult to perform, more serious in its demands, dealing with so infinite a variety of perverted relations. The growth is apt to be fixed on all sides by adhesions which are not readily separated, and the topography of the part is wholly altered.

When the anterior surface of the growth is reached, the next step is to attack at once the most dangerous region—the inner margin —where are found the vessels in the carotid sheath. This is accomplished principally with the Allis blunt dissector, which has justly been denominated one of the most useful of all surgical instruments. Two or three sharp curved retractors are used to great advantage to separate the tissues from the tumor, their location being changed frequently as the dissection continues, and the tumor also is pulled and rolled out by them, rather than seized by vulsellas, in the most advantageous way to aid in its extirpation. No tissue is cut or torn by the dissector until it has been carefully examined. One assistant sponges continually and is ready to make digital pressure should large vessels be wounded, while the other clamps the bleeding vessels as soon as they are cut. Hemorrhage is often serious owing to the numerous vessels which are large and thin-walled, especially if the tumor be of rapid growth. If these vessels are small and cannot be isolated from the tumor they are temporarily clamped and incised, but if they are of any material size a double ligature is at once thrown around them and the vessel cut between the two. The jugular itself may be so connected with the malignant growth that it

will be impossible to isolate it, and it is accordingly divided between two ligatures, and no serious results follow the division. If it be wounded slightly a lateral ligature of fine silk mends the rent. The writer has seen the internal jugular unavoidably torn or cut on several occasions, and each time air entered the vein—in one of the cases air being sucked in five times—without the slightest untoward symptom. If this accident occurs the rent is instantly closed by the finger till the vein can be tied.

The growth may extend deep down into the tissues of the neck, and may have so insinuated itself among the various structures as to make this part of the operation most difficult and even desperate. The recurrent laryngeal presents a source of danger and, together with the phrenic, pneumogastric, sympathetic, and descendens noni, is to be avoided.

The dome of the pleura may be injured, and air be sucked into the pleural cavity. Should this occur the opening is at once clamped with forceps and closed with a running catgut suture, or is packed with iodoform gauze. A small amount of air in the pleural cavity will not be of any serious consequence and will soon be absorbed.

The posterior surface of the tumor is dissected loose and the mass rolled over by means of the sharp retractor, and the dissection continued until it is finally removed. Attention is now paid to the bleeding vessels. The smaller vessels are controlled by torsion, the larger ones ligated with strong catgut or fine silk, oozing from the tissues being con-

trolled with successive gauze pads wrung out in hot water, and applied to the raw surface. Should bleeding points persist after the application of hot water they are controlled by additional catgut ligatures. Clots are removed by flushing with hot sterilized water or salt solution, and the wound dried with a gauze pad. Bichloride of mercury solution is not applied to the wound as it is irritating to the tissues, and when used upon albuminoids like blood forms chemical combinations which are not antiseptic, and which may account for untoward effects of disinfection in former years.

If drainage is required a fenestrated rubber drain is sewed in the lower angle of the wound, and the incision closed with interrupted silkworm-gut sutures passed with a curved needle, the suture at the upper end of the wound being tied first; and as each successive one is tied an assistant makes pressure over the incision with a sponge to obliterate the wound cavity. No iodoform or other dusting powder is used. The anesthetic is stopped. An abundant gauze dressing is applied around the neck, over this a thick pad of sterile wood wool, and occasionally a piece of rubber dam on the outer surface of sufficient size to overlap the edges of the dressings. This is held in place with a wet gauze bandage, and a dry cotton bandage is applied over all, passing under the axilla, across the chest, around the head and over the back to hold not only the dressings but also the head in rather firm position. In place of wood wool the much cheaper pads made of the finest "excelsior" (the stringy

wood shavings used for packing fragile articles) are sometimes used. The excelsior is made into pads of various sizes by means of gauze and then sterilized.

The patient is lifted back to the rolling table, warm blankets are wrapped around him, and the anesthetist accompanies him to the ward where his bed has been thoroughly warmed with hot-water bottles. He is placed in bed and hot-water bottles are disposed around him, care being taken that he will not be burned, and he is carefully watched until he is fully out of the anesthetic and intelligence is entirely restored.

In all operations the general technique is practically the same, additional features being used as demanded by each separate case. In operations about the nose and mouth, in many of which a preliminary tracheotomy is usually recommended, Professor Keen nearly always avoids this additional operation by placing the patient in the full Trendelenburg position, that is to say at an angle of thirty-five to forty degrees. Blood, like water, cannot run up-hill, and this position avoids the difficulties which often arise from blood half-choking the patient and also the later great danger of aspiration pneumonia. By turning the head to one side most of the blood runs out of the mouth and the rest is easily removed by gauze sponges in forceps. This posture is used in all cases of cleft palate, tumors of the tonsil, nose, or pharynx, removal of the tongue, cancer of the lip, hare-lip, removal of the upper or lower jaw, etc. When a celiotomy is performed for the extirpation of abdominal tumors and opera-

tions on the viscera, the moment the abdomen is opened the chemical antiseptic solutions are replaced by sterile salt solution. To retain the intestines and keep them from encroaching upon the site of operation, Ashton's pads play a useful part. The required number of pads are kept in sterile water after they have been boiled, and a nurse has sole charge of these during operation. She prepares her hands and forearms by scrubbing with soap and water, rinsing with water and alcohol, and disinfects by the method employed by Kelly; the hands and forearms are immersed above the elbows in a saturated solution of potassium permanganate at a temperature of 110° F. until the skin is colored dusky-brown. This color is removed by a second immersion in a saturated solution of oxalic acid, at the same temperature, and rinsed in warm, sterile salt solution. She wrings out the pads in one pan of sterile water and transfers them to another until needed. The water in these pans is changed frequently by the nurse who attends to the solutions, the nurse having charge of the pads handling absolutely nothing but them alone. The number of pads used is not trusted to the memory but is written down on a blackboard, so there will be no controversy at the end of the operation whether any pads are missing, the number at hand corresponding to the number on the board.

Sterilized sheets cover the patient with the exception of the area disinfected for the operation, and towels are used sparingly as they have a tendency to become misplaced, especially if the patient struggles, not being fully

under the influence of the anesthetic. As soon as the patient leaves the clinic the soiled sponges and dressings are removed, the floor is mopped with bichloride solution, the operating table is cleansed, and the soiled sheets on the tables are replaced by clean ones. Instruments and needles are gathered from the trays and scrubbed with soap under the hot-water tap; they are wrapped in gauze, the blades of the knives being enveloped in cotton, and resterilized by boiling while the next case is being anesthetized, additional instruments being added according to the requirements of the case. Fresh solutions are made up and the surgeon and assistants disinfect their hands and don clean operating gowns. In order to avoid the possibility of carrying infection to other cases, even with this careful technique, infected cases are always reserved for the last. The rule, "clean" cases first, "infected" cases last, is an invariable one.

The patient after operation usually makes an uninterrupted recovery. In very serious cases, however, certain complications are liable to supervene, the management of which will be incorporated in a future article. I wish to thank Dr. Keen for permission to describe the technique which is so strictly carried out in the Jefferson Clinic.

1703 WALNUT STREET.